UNIVERSITY of WASHINGTON

ITHS | Institute of Translational Health Sciences
Accelerating Research. Improving Health.

Data QUEST
Data Quality Testing – DQe Tools
2/28/17

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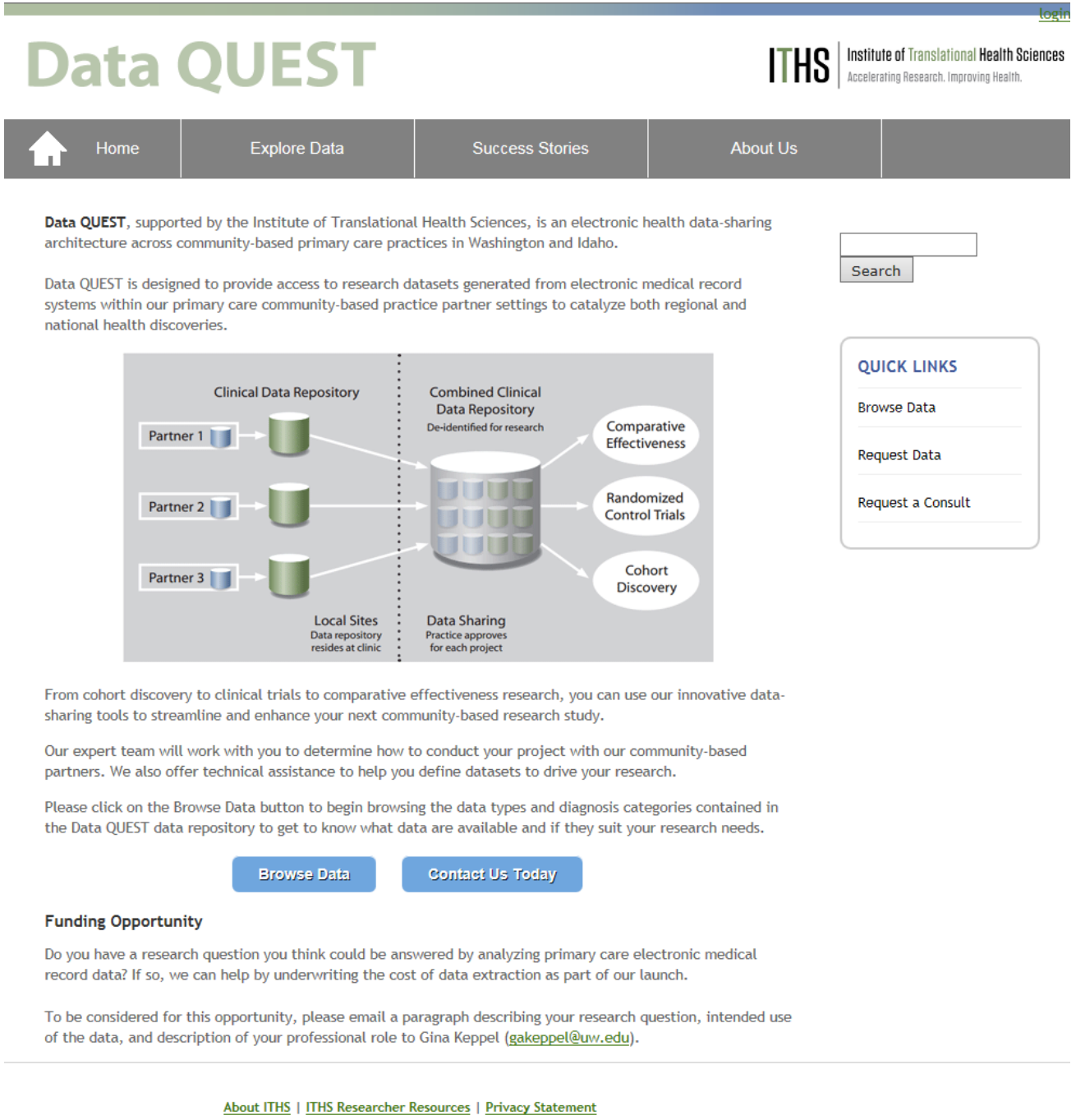
WWAMI region Practice & Research Network

WPRN
Collaborative Research. Innovative Care.

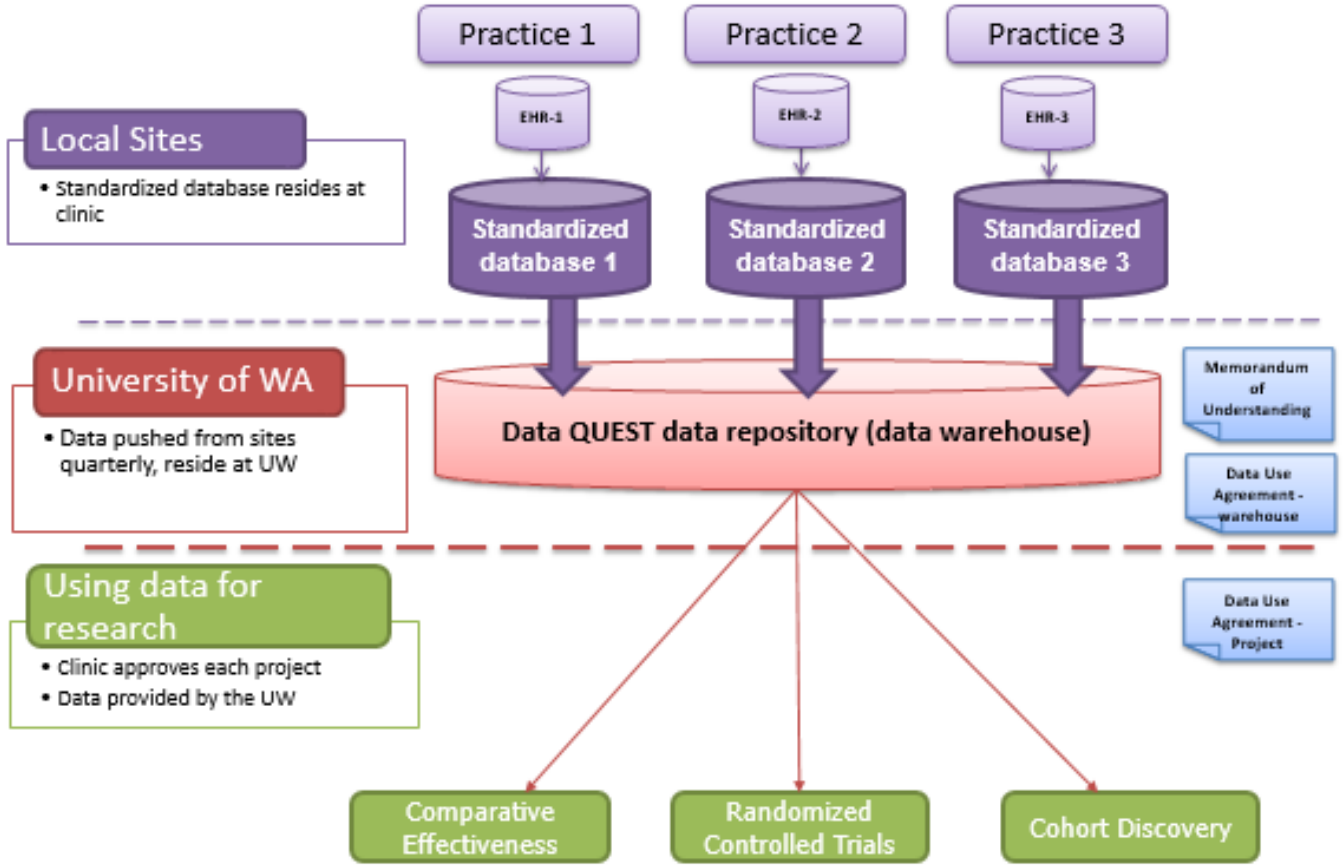
- ~58 Primary care WWAMI clinics
- ~20 data connected clinics
- CHCs and RHCs
- Underserved populations
- Many serving rural populations
- Collaboration with national network of practice based research networks
- Data QUEST represents over 250,000 patients
  https://dataquest.iths.org/
  https://github.com/WWAMI-DataQuest



Data QUEST

- 20 data-connected clinics in the WPRN
- Represents over 250,000 patients

An electronic health data-sharing architecture across community-based primary care practices in the WPRN



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Current Clinical Research Trials

- Team-based Safe Opioid Prescribing – dissemination trial across 6 regional primary care practices (AHRQ)
- Integrating Behavioral Health and Primary Care – large national pragmatic trial across 40 national primary care practices (PCORI)

Network Participation

- PCORNet's Patient-Centered Scalable National Network for Effectiveness Research (pSCANNER) (PCORI)
- Clinical Trials Network: Pacific Northwest Node (NIH/NIDA)
- Accelerating Change and Transformation in Organization and Networks III (ACTION III) partnership, The Quality Commons (AHRQ)
- WWAMI Practice Transformation Network (CMS)
- Diabetes Prevention Registry (CDC)
- Northwest Pharmacogenomic Research Network (NIH/NIGMS)
- DARTNet Practice Benchmarking Registry (industry)
- MOSAIC: Meaningful Outcomes and Science to Advance Innovations Center of Excellence (AHRQ)

Data QUEST: Improving Health in Rural Populations

funded by NIH, AHRQ, CDC, PCORI, AHRQ, CMMS, and industry

Common Tables – OMOP V.4

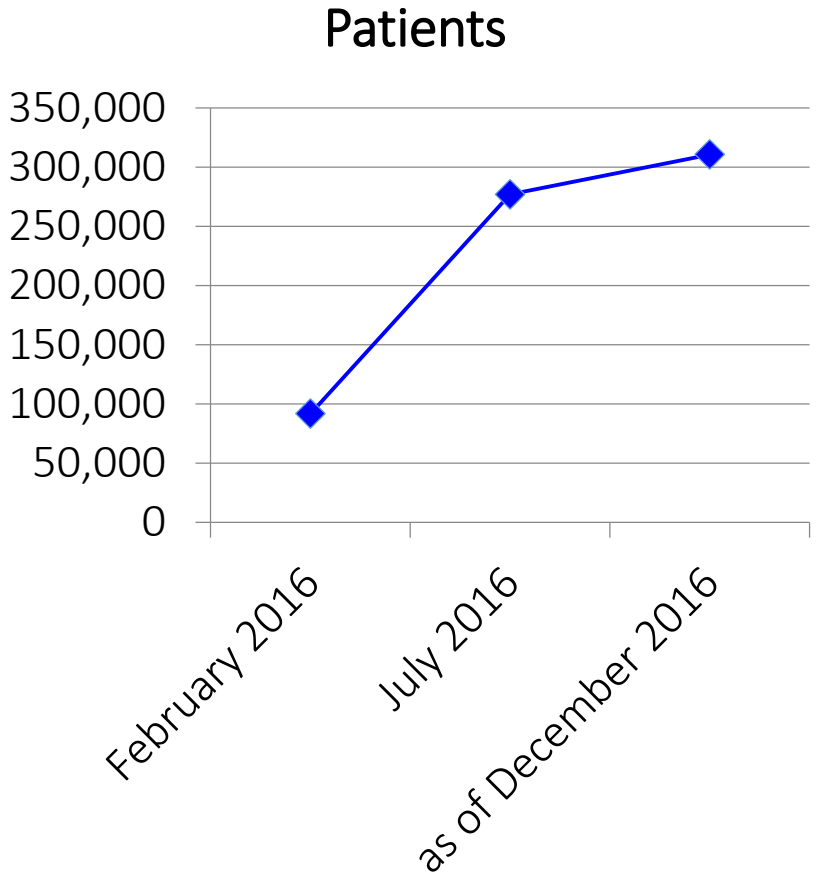
- Care Site
  - Sites at each organization
- Condition Occurrence
  - Encounter associated diagnoses
  - Problem list diagnoses
- Drug Exposure
  - Medications
- Location
  - Patient and site addresses
- Observation
  - Vitals and Labs
  - Past medical history
  - Family history
- Person
  - Patient demographics
- Procedure Occurrence
  - Encounter associated procedures
  - CPT codes
- Visit Occurrence
  - Appointments
  - Encounters

Current UW-hosted Data QUEST Warehouse Patients

310,604 patients in the person table

- 102,330 (33%) at Organization B
- 45,685 (15%) at Organization C
- 27,577 (9%) at Organization N
- 36,001 (12%) at Organization P
- 99,011 (32%) at Organization Y

10M encounters



Measuring Data Quality
A new framework…

Operationalizing the framework into: 5 conceptual tests and 17 discrete tests across:

Completeness	• Are the data present?
Conformance	• Are the data standardized and formatted?
Plausibility	• Are the data believable?

Kahn et al. (2016). A harmonized data quality assessment terminology and framework for the secondary use of electronic health record data. eGEMS, 4, 1244.
https://www.ncbi.nlm.nih.gov/pubmed/27713905

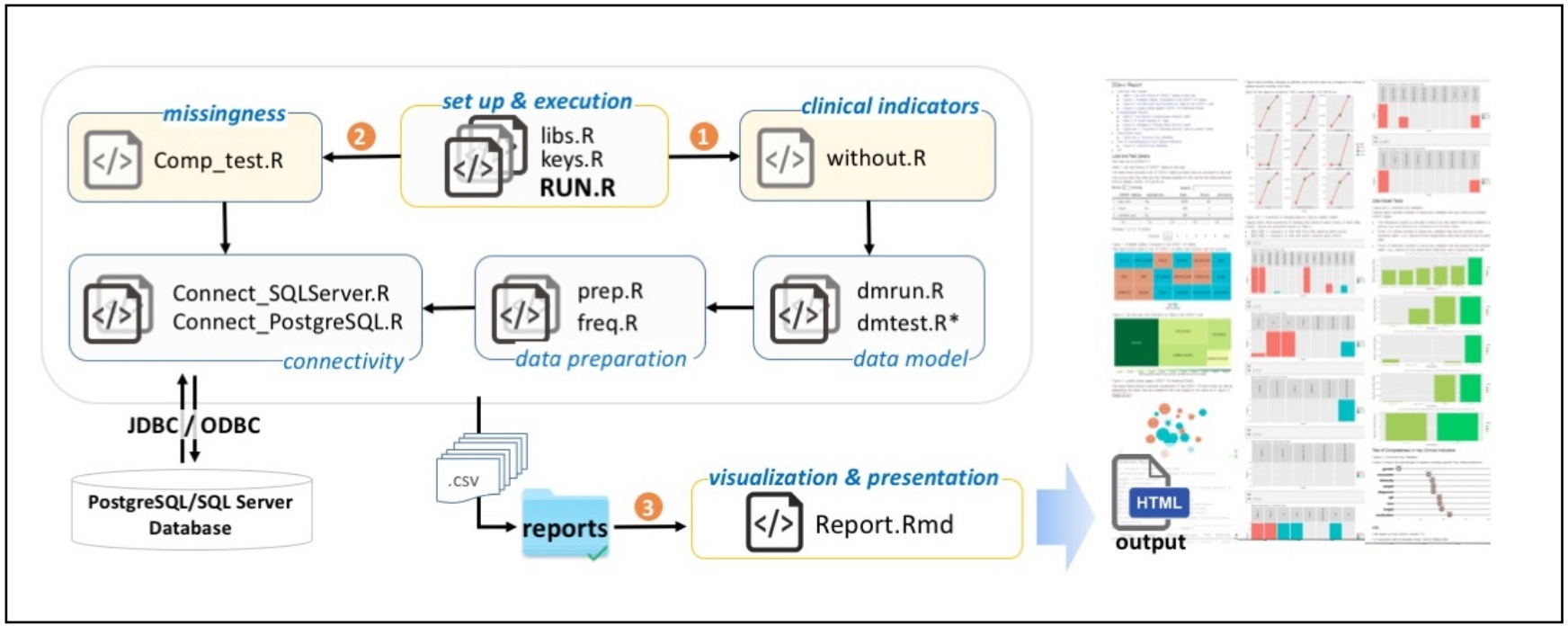
Data Quality Tests

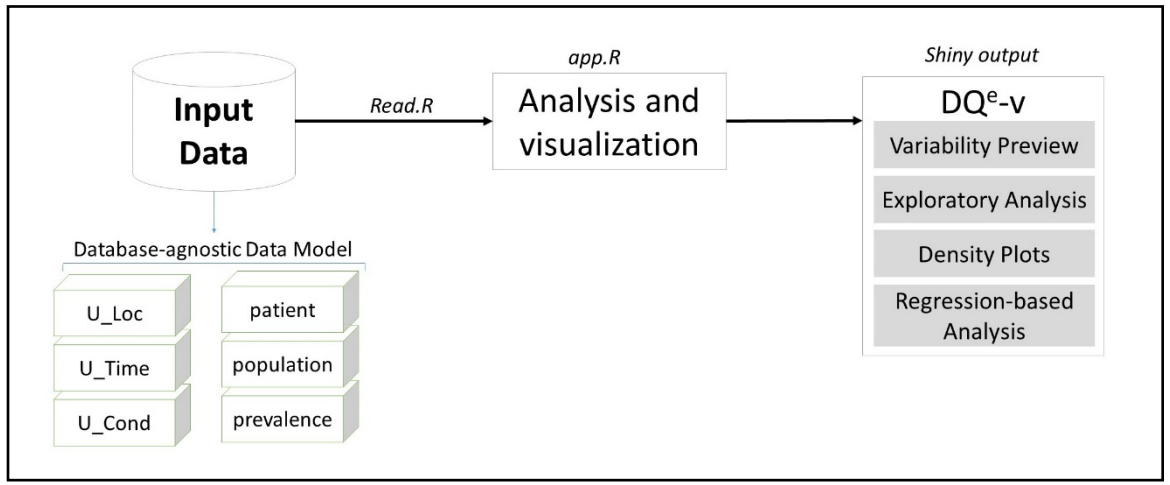
TEST ID	DOMAIN	TEST
C1	COMPLETENESS	Number of Tables Received, Number of Observations, Flag Indicator for the table having actual data
C2	COMPLETENESS	GENDER completeness (denominator and proportion with valid data)
C3	COMPLETENESS	AGE/DOB completeness (denominator and proportion with valid data)
C4	COMPLETENESS	VITALS completeness (denominator and proportion with valid data): Height, Weight, SBP, DBP
C5	COMPLETENESS	LABS completeness (denominator and proportion with valid data): A1c, HDL, LDL, Triglycerides, Total cholesterol
F1	FIDELITY	Check that primary and foreign keys relate properly; High Priority: Person_ID, Visit_Occurrence_ID
F2	FIDELITY	Duplicate patient check in the patient table (Find the same patient with a different patient ID using full name, dob, and gender)
F3	FIDELITY	Visualize codes/values entered for DEMOGRAPHICS (Gender, Race, Ethnicity)
F4	FIDELITY	Visualize YEAR OF BIRTH to help identify errors or missing cohorts
P1	PLAUSIBILITY	Comparison of new load to old load (Number of observations, Number of unique patients, Number of tables with rows)
P2	PLAUSIBILITY	Review of minimum and maximum dates for tables with key dates; High Priority: Visit_Occurrence table
P3	PLAUSIBILITY	How many patients have a year of birth after their visit dates?
P4	PLAUSIBILITY	Check that certain observation types fall into specific ranges
P5	PLAUSIBILITY	Visualize number of visits in a year or across years
P6	PLAUSIBILITY	Visualize type of visit in a year or across years
P7	PLAUSIBILITY	Volume Check: Proportion of patients with visit data and select observation types
P8	PLAUSIBILITY	Logical Constraints Check

DQe Tool Architecture

DQe-c

modular tool developed in R statistical language for assessing completeness in EHR data repositories





DQe-v

interactive interface powered by the shiny package version 0.13.0 in R

Operationalizing use of DQe tools for data quality testing

* Data QUEST
* DARTNet Institute

DQe-c/DQe-v Reports Standard Operating Procedure (SOP)

Version 2 December 2016

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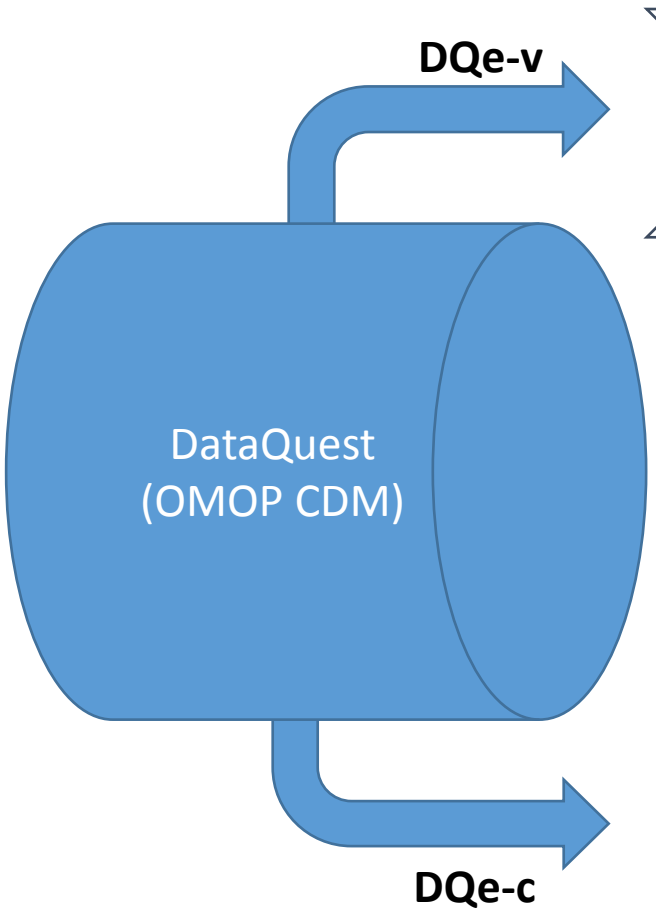
DQe-c and DQe-v Report Flows



Create a dataset of data quality related measures (for instance, visits per year) sorted by measure, organization, and year

Read the data and run the DQe-v R script

Review HTML output for data quality issues related to plausibility across multiple organizations

Main DQe-c Report ⟶ DQe-c Add-On

Run the DQe-c R script against the CDM for each organization individually

Review HTML output of individual DQe-c reports for data quality issues related to completeness, fidelity, and plausibility

Run R script for the DQe-c Add-On against the individual organization report files generated during the main DQe-c report process

Review HTML output of the DQe-c Add-On report for data quality issues related to completeness, fidelity, and plausibility ACROSS multiple organizations

Figure 3. Loaded tables against OMOP V4 Relational Model.

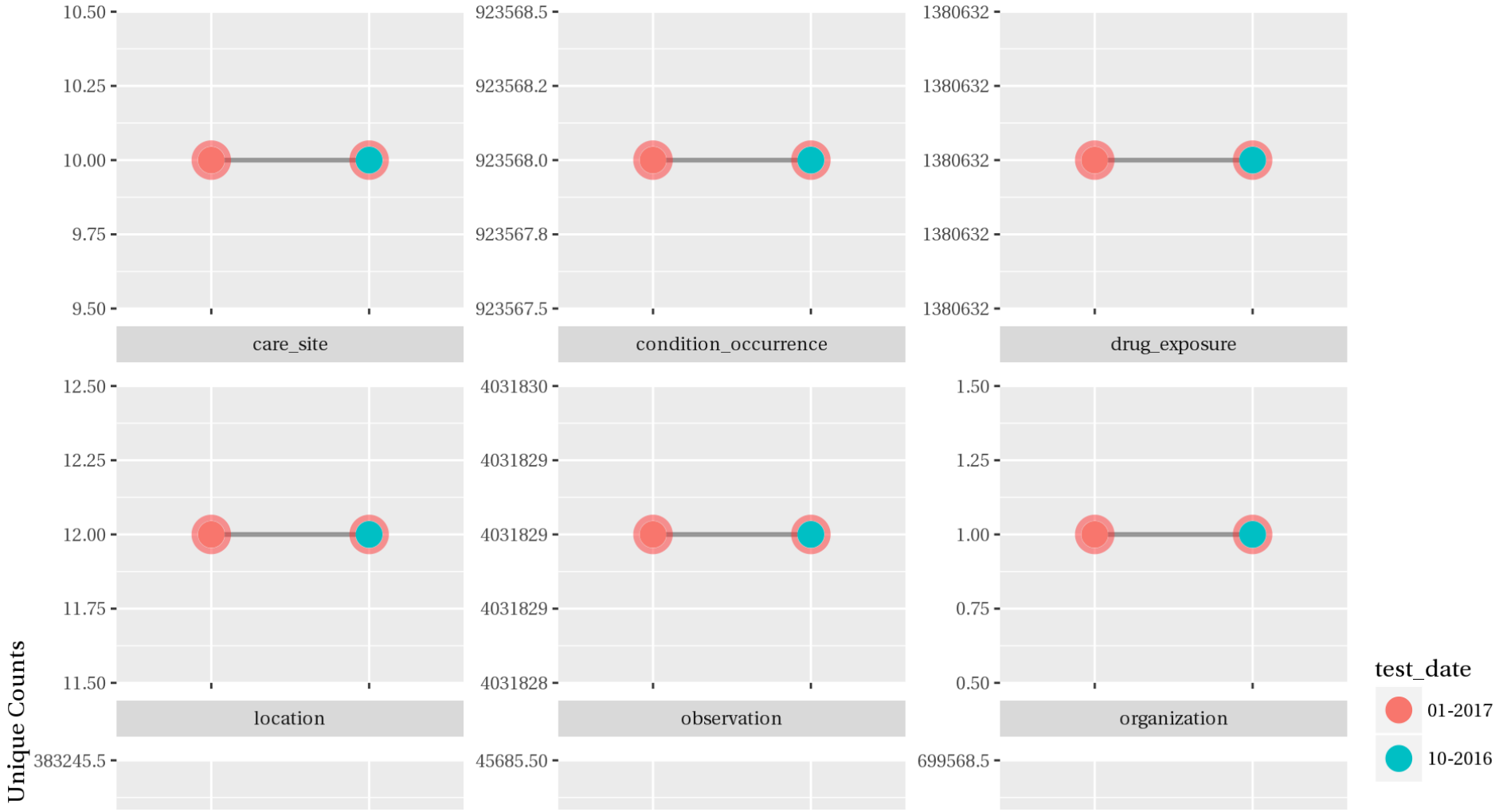
The figure below shows a network visualization of the OMOP V4 data model, as well as highlighting the tables that are available in this load (legend is the same as in Figure 1).

Select by id

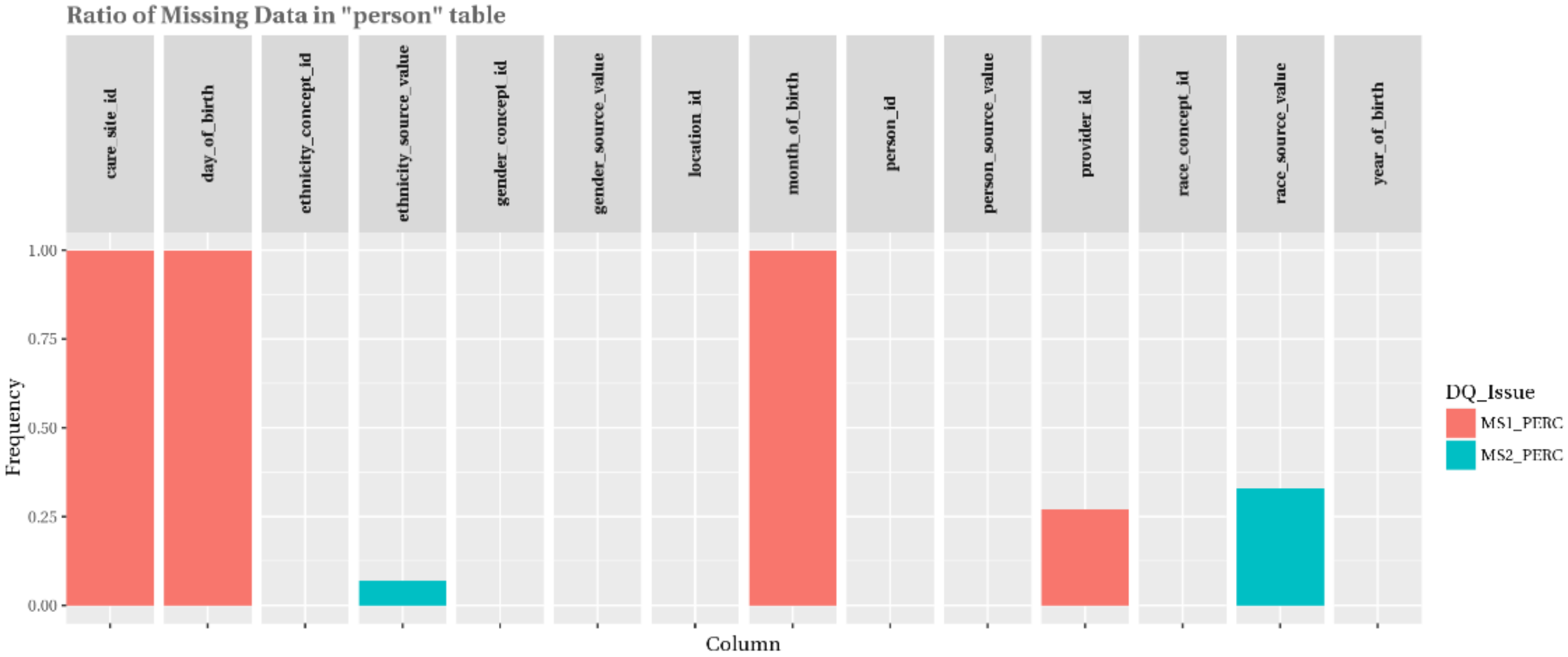
The network's table schemas and key relationships

- Color coated to display "missingness"

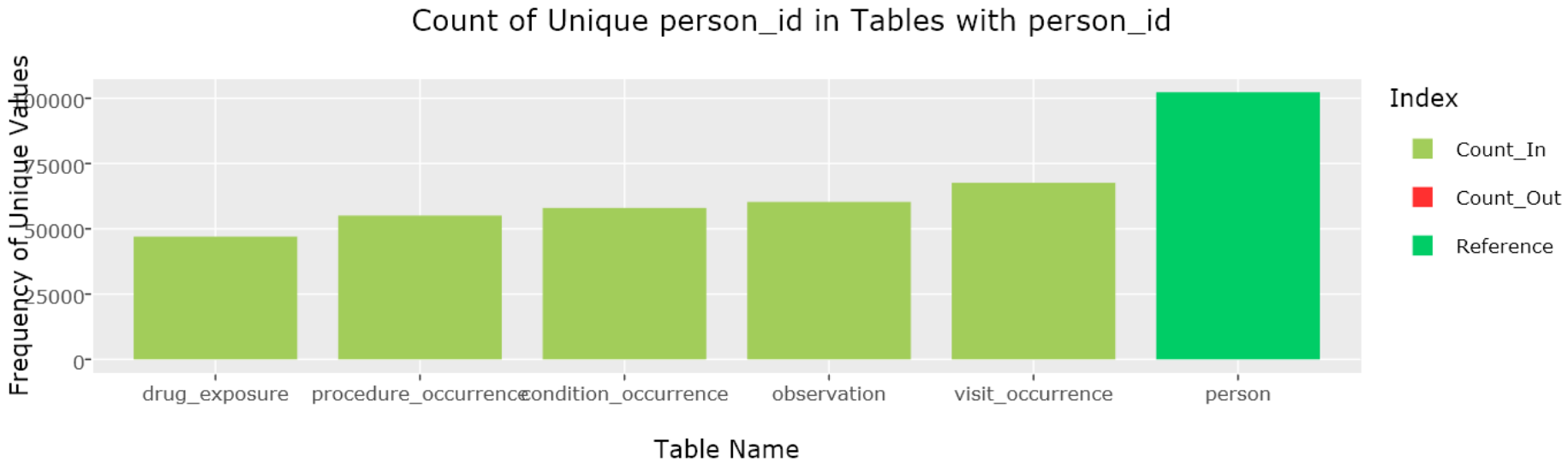
Completeness example:
Number of primary keys for available tables over time

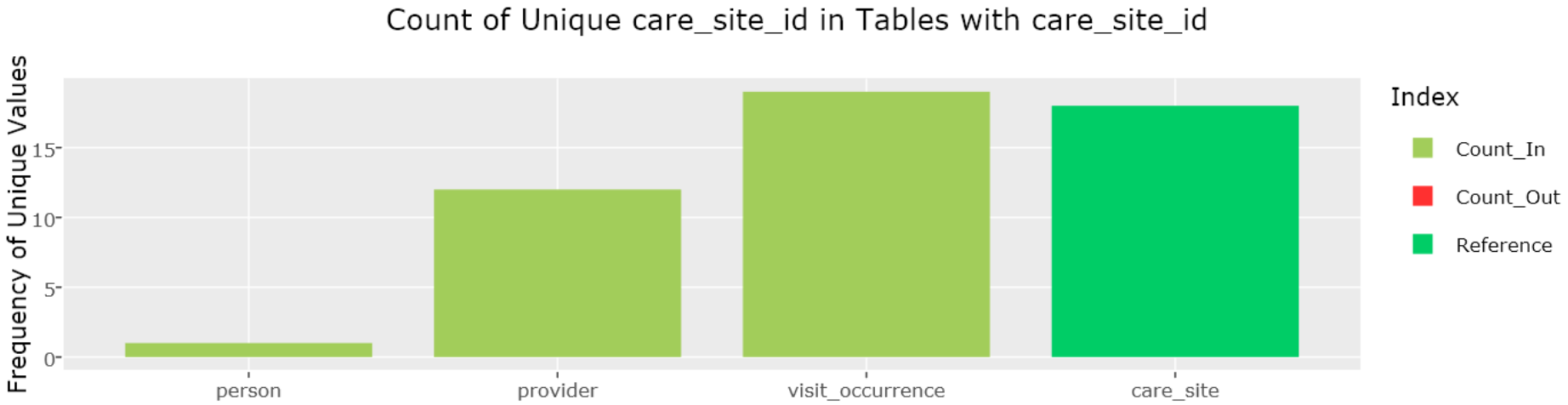


Completeness example:
Detailing columns with proportion of missingness (null vs. blank)

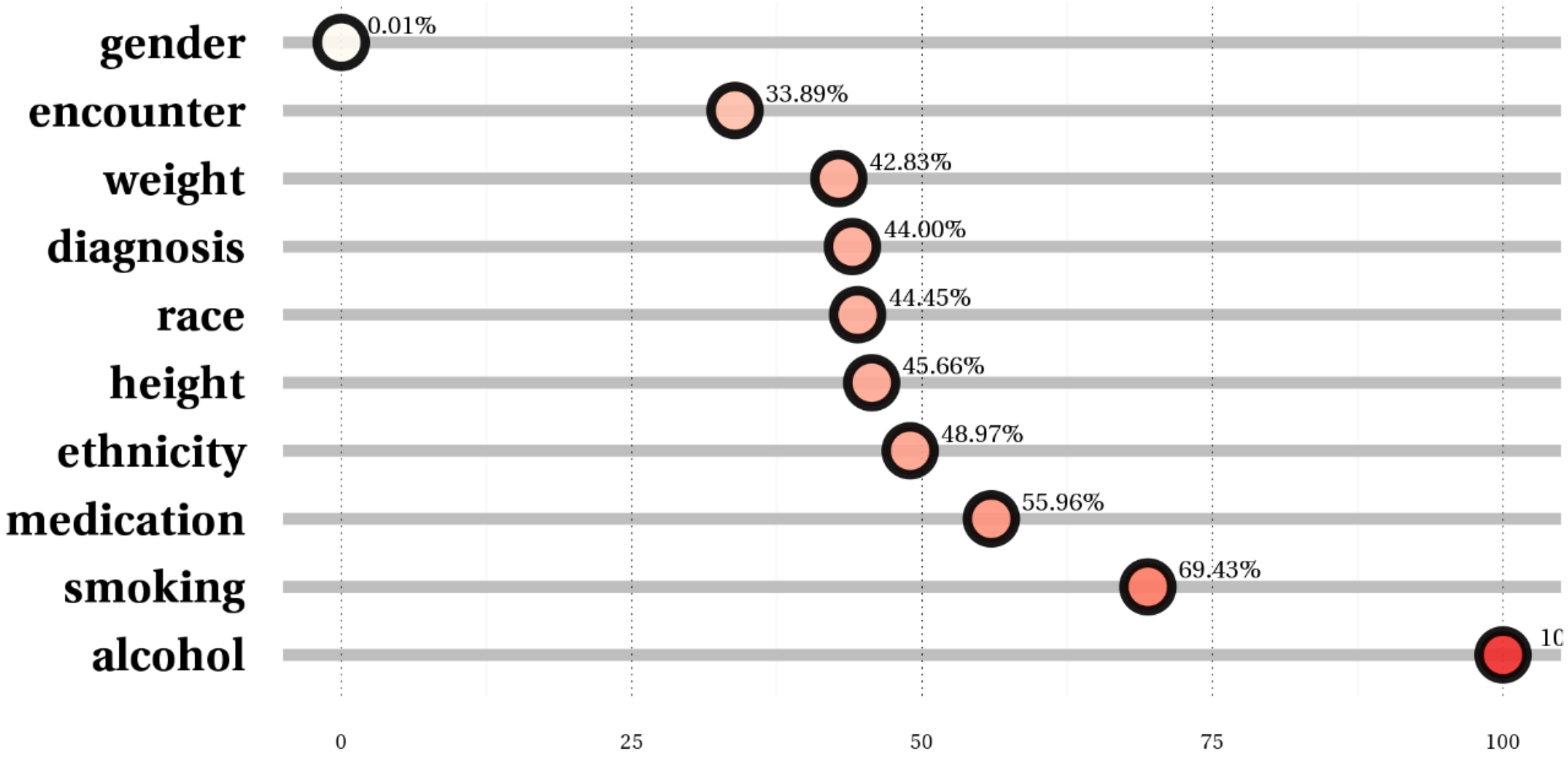


Fidelity example:
Detailing totals of key overlap across core tables



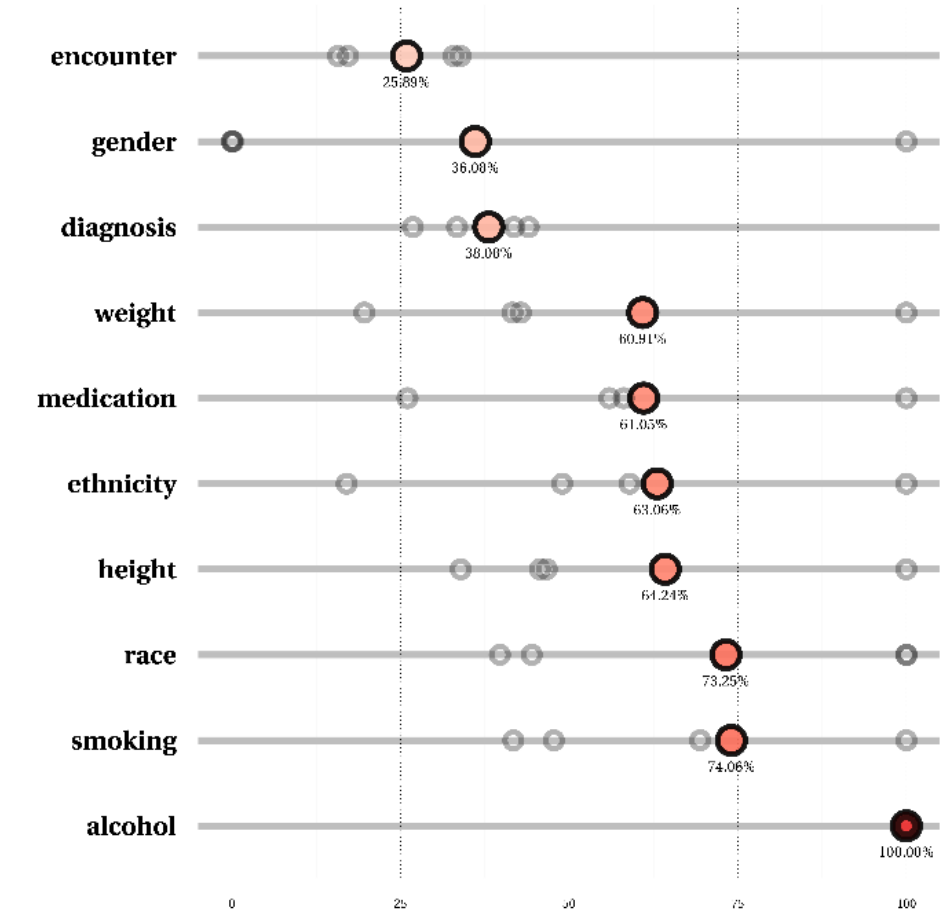


Completeness/Fidelity example:
Percent of patients missing specific key clinical indicators

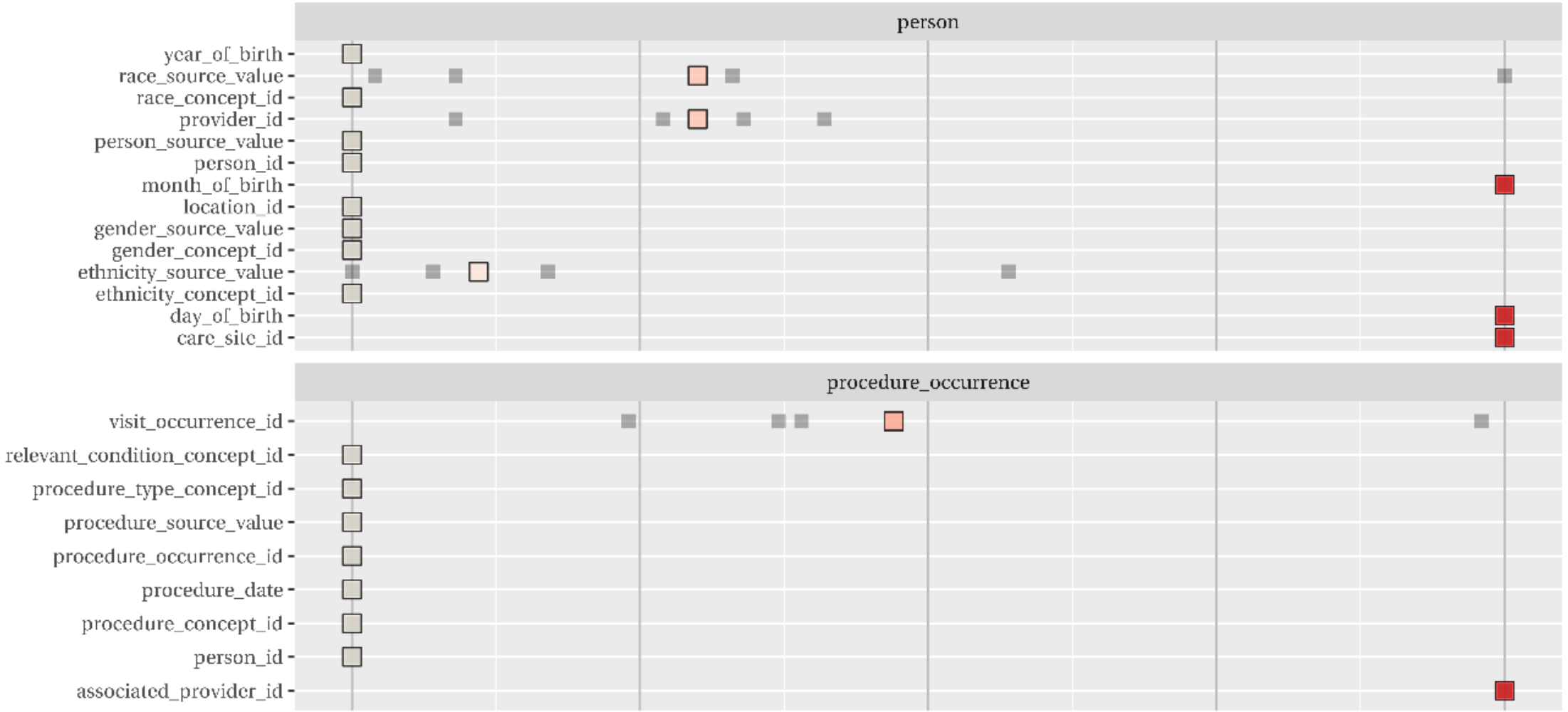


Completeness/Fidelity example across sites:
Percent of patients missing specific key clinical indicators

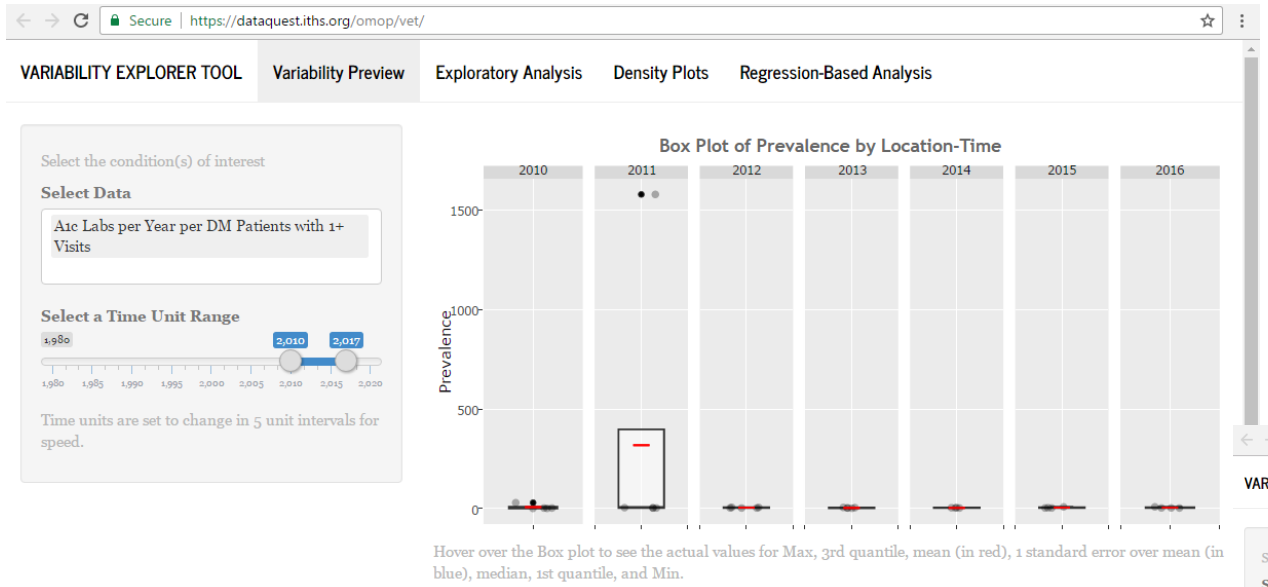
Figure 2. Overall missingness in key indicators



Completeness example across sites/clinics:
Percent of patients missing in columns across sites



Plausability example across sites/clinics:
of Hemoglobin A1c's per year per diabetes patient with 1+ visit



Zoom to 2015-16

Next Steps

- Finalize SOP manual for DQe
- Iterate and refining functionality in DQe-v
- Create standard report of data quality findings
- Add new tests as needed…

Thank you!

Contact: Kari Stephens
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https://dataquest.iths.org/

https://github.com/WWAMI-DataQuest